CLAIMS:

1. An apparatus, comprising:

a first cylinder surface region having a first surface roughness, the first cylinder surface region including at least a portion that is adapted to contact a reciprocating piston when the reciprocating piston is positioned at its top dead point, wherein a hard chromium layer is disposed on the first cylinder surface region, and

a second cylinder surface region having a second surface roughness, the second cylinder surface region including at least a portion that is adapted to contact the reciprocating piston when the reciprocating piston is positioned at its bottom dead point, wherein a topochromium layer is disposed on the second cylinder surface region and the second cylinder surface region is rougher than the first cylinder surface region.

2. An apparatus according to claim 1, wherein the first surface roughness is in the range of about Rz 1-20 microns.

3. An apparatus according to claim 1, wherein the second surface roughness is in the range of about Rz 4-50 microns.

4. An apparatus according to claim 3, wherein the first surface roughness is in the range of about Rz 1-20 microns.

5. An apparatus according to claim 4, wherein the roughness of the second cylinder surface region increases in the direction from the first cylinder surface region towards the bottom dead point of the reciprocating piston, the roughness increasing continuously, stepwise or both.

6. An apparatus according to claim 5, wherein the roughness in the first cylinder surface region increases in the direction from the top dead point towards the second cylinder surface region, the roughness increasing continuously, stepwise or both.

7. An apparatus according to claim 4, wherein the cylinder wall and the reciprocating piston define a compression chamber and the cylinder wall and the reciprocating piston are

arranged and constructed to withstand a pressure of at least 80 bar within the compression chamber.

8. An apparatus according to claim 7, wherein the cylinder wall and the reciprocating piston are arranged and constructed to withstand a pressure of between about 80-140 bar within the compression chamber.

9. An apparatus according to claim 7, further comprising an uppermost piston ring and a lowermost piston ring disposed around the piston and wherein the first cylinder surface region extends along at least 5% of a total length of a sliding path defined between the uppermost piston ring when the piston is disposed in its top dead point and the lowermost piston ring when the piston is disposed at its bottom dead point.

10. An apparatus according to claim 9, wherein the first cylinder surface region extends along at least 40% of the total length of the sliding path.

11. An apparatus according to claim 9, wherein the first cylinder surface region extends along about 40-80% of the total length of the sliding path.

12. An apparatus according to claim 1, wherein the first surface roughness is in the range of about Rz 2-5 microns and the second surface roughness is in the range of Rz 4-8 microns, the first cylinder surface region extends along at least 50% of a total sliding path of the reciprocating piston, the topochromium layer comprises a plurality of substantially half-sphere-shaped protrusions, in which oil reservoirs are defined in recesses between the protrusions, the hard chromium layer and the topochromium each independently have a thickness in the range of about 10-50 microns, and wherein the cylinder wall and the reciprocating piston define a combustion chamber therein and the combustion chamber is arranged and constructed to withstand a pressure of between about 80-140 bar.

13. A method comprising,
supplying diesel fuel to the combustion chamber of the apparatus of claim 12, and
igniting the diesel fuel, thereby driving the piston towards its bottom dead point.

14. A method comprising,

supplying diesel fuel to the apparatus of claim 1, and

igniting the diesel fuel, thereby driving the piston towards its bottom dead point.

15. An apparatus, comprising:

a first cylinder surface region having a first surface roughness, the first cylinder surface region including at least a first portion of a cylinder wall that is adapted to contact a reciprocating piston when the reciprocating piston is positioned at its top dead point, wherein a hard chromium layer having a thickness of between 10-50 microns is disposed on the first cylinder surface region and the first surface roughness is in the range of about Rz 1-20 microns, and

a second cylinder surface region having a second surface roughness, the second cylinder surface region including at least a second portion of the cylinder wall that is adapted to contact the reciprocating piston when the reciprocating piston is positioned at its bottom dead point, wherein a topochromium layer having a thickness of between 10-50 microns is disposed on the second cylinder surface region, the second surface roughness is in the range of about Rz 4-50 microns, the second cylinder surface region is rougher than the first cylinder surface region and the topochromium layer is characterized by comprising a plurality of substantially half-spherical protrusions in which a plurality of oil reservoirs are defined between the protrusions.

16. An apparatus according to claim 15, wherein the cylinder wall and the reciprocating piston define a combustion chamber and the combustion chamber is arranged and constructed to withstand a pressure of between about 80-140 bar, and wherein the first cylinder surface region extends along about 40-80% of a total length of a sliding path defined along the cylinder wall by the reciprocating piston.

17. An apparatus according to claim 16, wherein the first surface roughness is in the range of about Rz 2-5 microns and the second surface roughness is in the range of Rz 4-8 microns, the first cylinder surface region extends along at least 60% of the total sliding path, and wherein the combustion chamber is arranged and constructed to withstand a pressure of between about 120-140 bar.

18. A method comprising,

supplying diesel fuel to the combustion chamber of the apparatus of claim 17, and

igniting the diesel fuel, thereby driving the piston towards its bottom dead point.

19. A method of making a cylinder surface having differing surface roughness, comprising:

disposing a rod-shaped electrode within a cylinder wall, the rod-shaped electrode having at least first and second segments, the first segment being electronically isolated from the second segment,

disposing the electrode and the cylinder wall in a liquid comprising chromium ions, and

applying a substantially constant current to the first segment and simultaneously applying a step-wise changing current to the second segment, whereby a topochromium layer is formed on a portion of the cylinder wall opposing the second segment, the topochromium layer comprising a plurality of substantially half-sphere shaped protrusions defining recesses therebetween.

20. A method as in claim 19, further comprising applying the step-wise changing current to the second segment such that the portion of the cylinder wall opposing the second segment has a surface roughness in the range of about Rz 4-50 microns and applying the substantially constant current to the first segment, such that a portion of the cylinder wall opposing the first segment has a surface roughness in the range of about Rz 1-20 microns.